



BOTSWANA EXAMINATIONS COUNCIL
Botswana General Certificate of Secondary Education

CANDIDATE
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SCIENCE: DOUBLE AWARD

0569/03

Paper 3 Theory

October/November 2020

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your candidate name, Centre number and candidate number in the spaces provided at the top of this page.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs or rough working.

Do **not** use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Write your answers in the spaces provided on the Question Paper.

The number of marks is given in brackets [] at the end of each question or part question.

You may lose marks if you do not show your working or if you do not use appropriate units.

You may use a calculator.

A copy of the Periodic Table is printed on page 20.

For Examiner's Use	
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Total	

This document consists of **17** printed pages and **3** blank pages.

[Turn over



1 A shopkeeper lifts a bag of sugar of 12.5 kg from the floor to a shelf of height 1.2 m in 8.56 s.

(a) State the main energy change that occurs on the bag as it is being lifted.

..... to [2]

(b) State the relationship between work and energy.

.....
..... [1]

(c) Calculate:

(i) the work done in lifting the bag of sugar,
($g = 10 \text{ N/kg}$)

work done =J [2]

(ii) the power developed by the shopkeeper.

power =W [2]

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- 2 Fig. 2.1 shows two rods of the same size placed in hot water. One rod is made of steel and the other is made of wood.

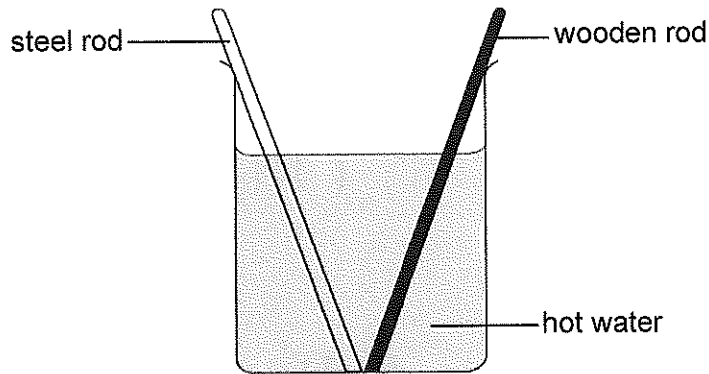


Fig. 2.1

- (a) State the rod that would feel hotter when the top of each rod is touched after 5 minutes. Explain your answer.

rod

explanation

..... [1]

- (b) State **two** ways in which thermal energy is being lost from the hot water.

1.

2. [2]

- (c) Describe how the thermal energy is transferred through a solid.

.....

.....

..... [2]

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- 3 Fig. 3.1 shows sound waves produced by a loudspeaker. C is the compression and R is the rarefaction.

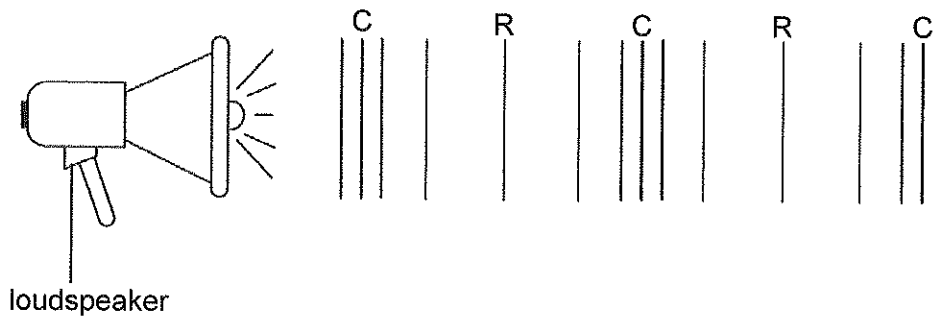


Fig. 3.1

- (a) State the type of waves produced by the loudspeaker.

..... [1]

- (b) On Fig. 3.1, mark the wavelength of the wave.

[1]

- (c) (i) 75 complete waves pass a point in one second.

State the frequency of the wave.

frequency =Hz [1]

- (ii) The wavelength of the wave is 4.2 m.

Calculate the speed of the wave.

speed = m/s [2]

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- 4 Fig. 4.1 shows an electric circuit.
A battery with a 12.0 V electromotive force is connected in series with a 2.0 Ω resistor, resistor R and meter P.

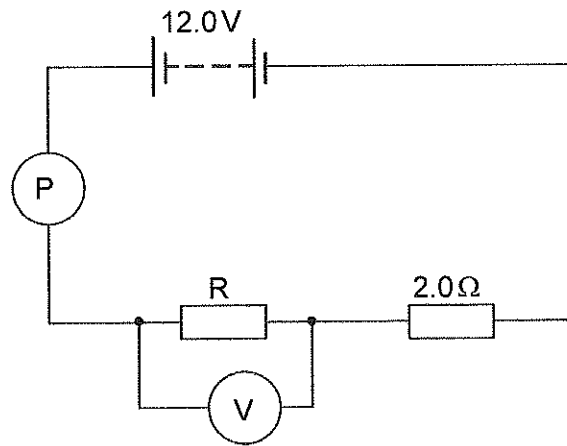


Fig. 4.1

- (a) State the meaning of 12.0 V electromotive force.

..... [1]

- (b) Meter P is used to measure the rate of flow of charge.

State the name of meter P.

..... [1]

- (c) A voltmeter connected across R reads 4.0 V.

Calculate the potential difference across the 2.0 Ω resistor.

potential difference = V [1]

- (d) Determine the resistance of resistor R.

resistance of R = Ω [3]

- (e) The 2.0 Ω resistor is now connected in parallel with resistor R.

State the effect of this change on the reading of meter P. Explain your answer.

effect

explanation

..... [2]

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5 Fig. 5.1 shows a simple alternating current generator.

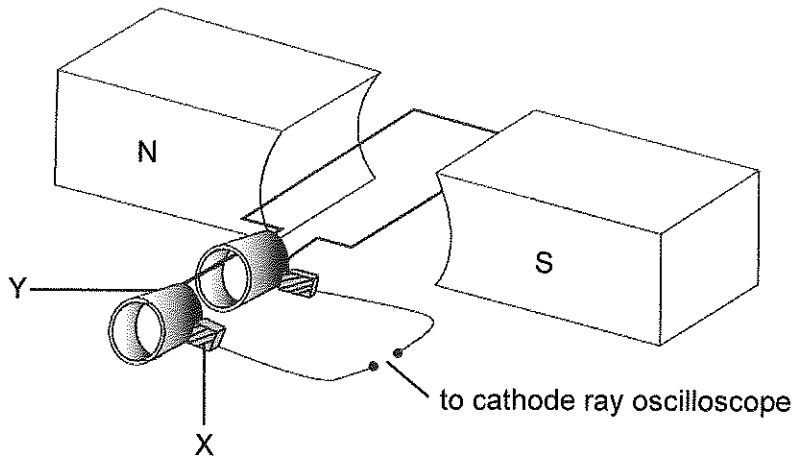


Fig. 5.1

(a) State the name of component X.

..... [1]

(b) Describe how the generator produces a current.

.....

 [3]

(c) Fig. 5.2 shows how the output voltage varies with time.

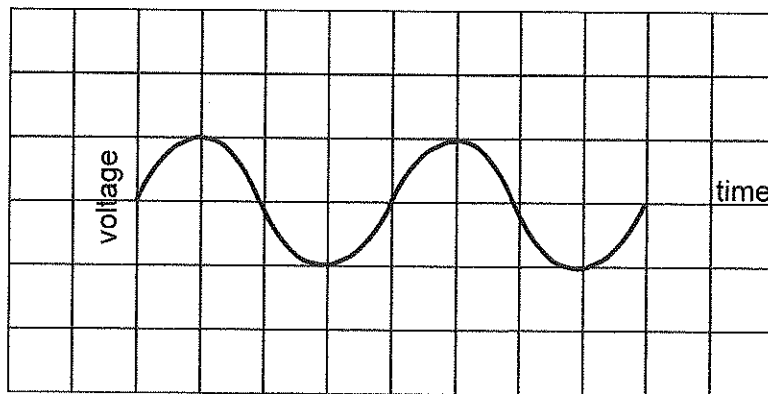


Fig. 5.2

The speed of rotation of the coil is doubled.

Suggest the effect this will have on the amplitude and the frequency of the waveform.

amplitude

frequency

[2]

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6 Fig. 6.1 shows a sign placed on the door of a room.

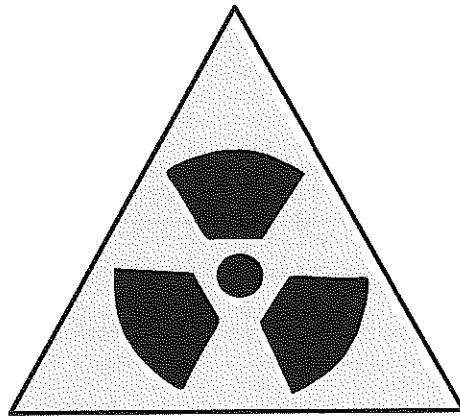


Fig. 6.1

(a) State the meaning of the sign.

..... [1]

(b) State any **two** precautions to be taken when entering the room.

1.

2. [2]

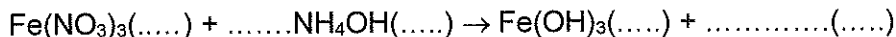
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8 Iron(III) nitrate solution reacts with ammonium hydroxide solution to form iron(III) hydroxide precipitate and ammonium nitrate solution.

(a) An incomplete equation for the reaction is shown.



Complete the equation by:

- writing the missing compound,
- writing the state symbols of all the compounds,
- balancing the equation.

[3]

(b) Calculate the relative molecular mass of iron(III) hydroxide, Fe(OH)₃.

[A_r: Fe, 56; O, 16; H, 1]

relative molecular mass = [1]

(c) Iron(III) nitrate solution reacts with aqueous potassium iodide, KI, solution.

The iron(III), Fe³⁺, ion changes to iron(II), Fe²⁺, ion.

(i) Describe a test that can be carried out to confirm the presence of the Fe²⁺ ions and state the result of the test.

test

result

[2]

(ii) State the name of the process that makes Fe³⁺ ions to change to Fe²⁺ ions.

..... [1]

(iii) Give a reason for your answer in (c)(ii).

..... [1]

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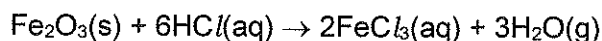
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- 9 (a) An impure sample of iron(III) oxide has a mass of 2.48 g.
The sample reacts completely with 200 cm³ of 0.208 mol/dm³ of dilute hydrochloric acid.
- (i) Calculate the number of moles in 200 cm³ of 0.208 mol/dm³ dilute hydrochloric acid.

moles = [2]

- (ii) The equation for the reaction is shown.



Use your answer to (a)(i) and the equation to calculate the number of moles of iron(III) oxide, Fe₂O₃, that reacted with the acid.

moles = [2]

- (b) (i) The relative molecular mass of Fe₂O₃ is 160.
Use your answer to (a)(ii) to calculate the mass of iron(III) oxide, Fe₂O₃, that reacted with the acid.

mass = [2]

- (ii) Use your answer to (b)(i) to calculate the percentage purity of the iron(III) oxide.

percentage purity = [2]

10 Pentane, C_5H_{12} , is an organic compound found in petrol. It has three structural isomers.

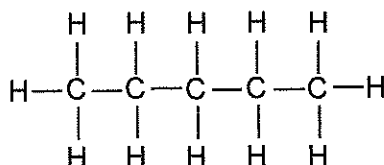
(a) (i) State the name of the homologous series to which pentane belongs.

..... [1]

(ii) Write the general molecular formula for this homologous series.

..... [1]

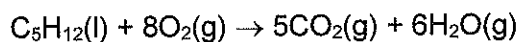
(b) One of the structural formulas of the isomers of C_5H_{12} is shown.



Draw **two** other isomers of C_5H_{12} .

[2]

(c) Pentane burns in oxygen to form carbon dioxide and steam. The equation for the reaction is shown.



(i) State another type of reaction that pentane undergoes.

..... [1]

(ii) State the name of **one** source of C_5H_{12} .

..... [1]

(iii) Carbon dioxide dissolves in water to form an acidic solution.

Suggest the pH of the solution. Explain your answer.

suggestion

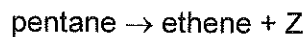
explanation.....

.....

[2]



(d) The equation represents the cracking of pentane C_5H_{12} .



(i) State the name of substance Z.

..... [1]

(ii) Draw a 'dot' (•) and 'cross' (×) diagram to show the bonding in a molecule of ethene, C_2H_4 . Show electrons in the outer shells only.

[2]

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11 Fig. 11.1 shows the structure of one type of a white blood cell.

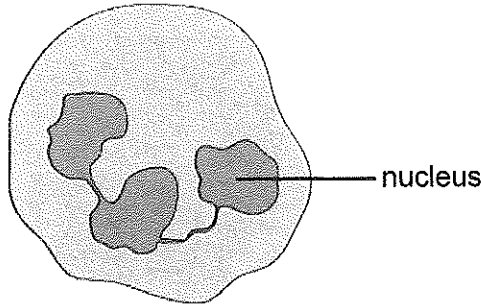


Fig. 11.1

(a) State the function of the cell shown in Fig. 11.1.

.....

..... [1]

(b) State **two** ways in which the structure of the cell shown in Fig. 11.1 differs from that of a palisade cell from a leaf.

1.

2. [2]

(c) The virus which causes AIDS attacks and destroys white blood cells after entering the human body.

(i) State the name of the virus that causes AIDS.

..... [1]

(ii) State **two** ways in which this virus can be transmitted from an infected person to another person.

1.

2. [2]

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12 Fig. 12.1 shows a diagram of the human digestive system.

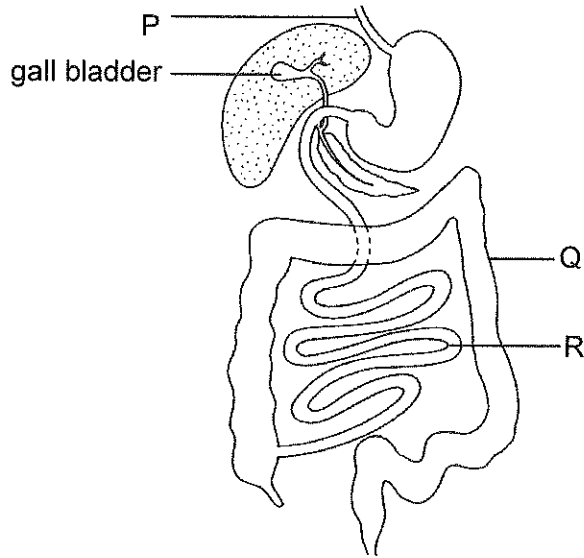


Fig. 12.1

(a) State the names of the parts labelled P and Q on Fig. 12.1.

P

Q

[2]

(b) State the function of the part labelled R.

..... [1]

(c) Gastric by-pass is a surgical operation done to reduce the size of the stomach.

Suggest how this operation helps an obese person to lose weight.

.....

.....

.....

..... [3]

(d) Describe the effect of removing the gall bladder on the digestion of food.

.....

..... [2]

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13 A farmer adds a nitrate fertiliser on a field.

(a) Describe how nitrate ions are absorbed by plants from the soil.

.....

.....

.....

..... [3]

(b) Fig. 13.1 shows the effect of the fertiliser on plant growth.

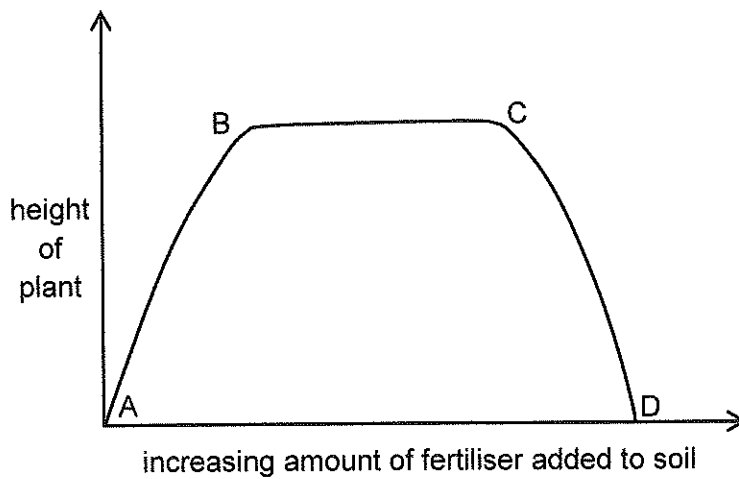


Fig. 13.1

(i) Explain the shape of the graph from A to B.

.....

.....

.....

..... [4]

(ii) The farmer increases the amount of fertiliser and notices that from C to D some plants started dying.

Explain the likely causes of the death of the plants.

.....

.....

.....

..... [4]

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14 Lactase from a fungus is used to produce lactose-free milk.

Fig. 14.1 shows how the rate of enzyme reaction is affected by temperature.

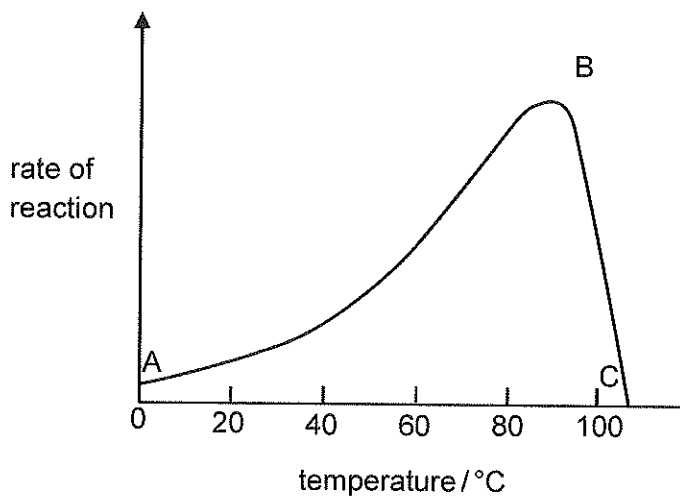


Fig. 14.1

(a) (i) Define the term *enzyme*.

.....
 [2]

(ii) State **one** property of enzymes, other than being temperature sensitive.

..... [1]

(b) Explain the shape of the graph from A to B, at B and from B to C.

A to B

 B
 B to C
 [3]

(c) On Fig. 14.1, draw a curve you would expect if lactase from a human being was used, rather than the lactase obtained from a fungus.

[2]

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DATA SHEET The Periodic Table of the Elements

Group																																																																																																											
I	II	III	IV	V	VI	VII	0																																																																																																				
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	19 F Fluorine 9	20 Ne Neon 10	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	58 Ce Cerium 58	59 Pr Praseodymium 59	60 Nd Neodymium 60	61 Pm Promethium 61	62 Sm Samarium 62	63 Eu Europium 63	64 Gd Gadolinium 64	65 Tb Terbium 65	66 Dy Dysprosium 66	67 Ho Holmium 67	68 Er Erbium 68	69 Tm Thulium 69	70 Yb Ytterbium 70	71 Lu Lutetium 71	72 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104 Fr Francium 87	105 Ra Radium 88	106 Ac Actinium 89	107 Th Thorium 90	108 Pa Protactinium 91	109 U Uranium 92	110 Np Neptunium 93	111 Pu Plutonium 94	112 Am Americium 95	113 Cm Curium 96	114 Bk Berkelium 97	115 Cf Californium 98	116 Es Einsteinium 99	117 Fm Fermium 100	118 Md Mendelevium 101	119 No Nobelium 102	120 Lr Lawrencium 103	121 Fr Francium 87	122 Ra Radium 88	123 Ac Actinium 89	124 Th Thorium 90	125 Pa Protactinium 91	126 U Uranium 92	127 Np Neptunium 93	128 Pu Plutonium 94	129 Am Americium 95	130 Cm Curium 96	131 Bk Berkelium 97	132 Cf Californium 98	133 Es Einsteinium 99	134 Fm Fermium 100	135 Md Mendelevium 101	136 No Nobelium 102	137 Lr Lawrencium 103

*58-71 Lanthanoid series
 †90-103 Actinoid series

Key
 a = relative atomic mass
 X = atomic symbol
 b = proton (atomic) number